COVID-19 AND FLUID MANAGEMENT

- The global COVID-19 pandemic has sharply focused the attention of the world onto critical care as a specialty.
- we summarize what has been published on fluid strategies in COVID-19, guidelines available and provide some reflections on personal practice.

- Fluid therapy, either too much or too little, can adversely affect patient outcome.
- As an example, during the early stages of the COVID-19 pandemic, it was common advice to aim for a negative fluid balance. More recently, a higher than expected occurrence of acute kidney injury requiring renal replacement therapy has been observed, prompting calls for a more liberal fluid strategy.
- Given the incidence of myocardial dysfunction in a subset of patients ,early use of vasopressors/inotropes alongside regular assessment via echocardiography would be prudent.

Septic Shock and the Inflammatory Response Due to COVID-19

- Patients with COVID-19 may express high levels of an array of inflammatory cytokines, often in the setting of deteriorating hemodynamic or respiratory status. This is often referred to as “cytokine release syndrome” or “cytokine storm,” although these are imprecise terms.

Intensivists need to consider the full differential diagnosis of shock to exclude other treatable causes of shock :

- bacterial sepsis due to pulmonary or extra pulmonary sources
- hypovolemic shock due to a gastrointestinal hemorrhage that is unrelated to COVID-19
- cardiac dysfunction related to COVID-19 or comorbid atherosclerotic disease
- stress-related adrenal insufficiency

patients with COVID-19 who require fluid resuscitation or hemodynamic management of shock should be treated and managed identically to patients with septic shock.

NIH guideline
(national institute of health)

Recommendation

- For adults with COVID-19 and shock, the COVID-19 Treatment Guidelines Panel (the Panel)recommends using dynamic parameters, skin temperature, capillary refilling time, and/or lactate levels over static parameters to assess fluid responsiveness .

- Dynamic indices of volume responsiveness include passive leg raises, fluid challenges with serial stroke volume measurements, or variations in systolic pressure, pulse pressure, inferior vena cava size, or stroke volume in response to changes in intrathoracic pressure during mechanical ventilation.

Rationale

- No direct evidence addresses the optimal resuscitation strategy for patients with COVID-19 and shock.

- In a systematic review and meta-analysis of 13 non-COVID-19 randomized clinical trials dynamic assessment to guide fluid therapy reduced mortality , intensive care unit (ICU) length of stay and duration of mechanical ventilation.

- Dynamic parameters used in these trials included stroke volume variation (SVV), pulse pressure variation (PPV), and stroke volume change with passive leg raise or fluid challenge.
- stroke volume variation (SVV) is the difference in maximal SV and minimal SV during respiration. The greater difference the more fluid responsive a patient is likely to be.
- SVV greater than 10% would indicate fluid response.
- SV : difference between end diastolic volume and end systolic volume.

Pulse pressure variation (**PPV**), which quantifies the changes in arterial **pulse pressure** during mechanical ventilation, is one of the dynamic variables that can predict fluid responsiveness.

Pulse pressure is the difference between systolic and diastolic blood **pressure**.

- Passive Leg Raise (PLR) transiently increases venous return in patients who are preload responsive, as such it is a diagnostic test not a treatment it is a predictor of Fluid responsiveness.

TECHNIQUE

- sit patient at 45 degrees head up semi-recumbent position
- lower patient's upper body to horizontal and passively raise legs at 45 degrees up
- maximal effect occurs at 30-90 seconds
- assess for a 10% increase in stroke volume (cardiac output monitor) or using a surrogate such as pulse pressure (using an arterial line)

- Passive leg raising, followed by PPV and SVV, appears to predict fluid responsiveness with the highest accuracy.
- The static parameters included components of early goal-directed therapy (e.g., central venous pressure, mean arterial pressure).

- Resuscitation of non-COVID-19 patients with shock based on serum lactate levels has been summarized in a systematic review and meta-analysis of seven randomized clinical trials Compared with central venous oxygen saturation-guided therapy, early lactate clearance-directed therapy was associated with a reduction in mortality , shorter length of ICU stay and shorter duration of mechanical ventilation.

Recommendation

- For the acute resuscitation of adults with COVID-19 and shock, the Panel recommends using buffered/balanced crystalloids over unbalanced crystalloids.
- Balanced crystalloid:

  Ringer lactate

  Plasma-lyte

Rationale

- A pragmatic randomized trial that compared balanced and unbalanced crystalloids in 15,802 critically ill adults found that the rate of the composite outcome of death, new renal-replacement therapy, or persistent renal dysfunction was lower in the balanced crystalloids group
- A secondary analysis compared outcomes in a subset of patients with sepsis among the sepsis patients in the balanced crystalloids group, there were fewer deaths as well as fewer days requiring vasopressors and renal replacement therapy.

Recommendation

- For the acute resuscitation of adults with COVID-19 and shock, the Panel recommends against the initial use of albumin for resuscitation.

Rationale

- A meta-analysis of 20 non-COVID-19 randomized controlled trials that compared the use of albumin or fresh-frozen plasma to crystalloids in critically ill patients found no difference in all-cause mortality whereas a meta-analysis of 17 non-COVID-19 randomized controlled trials that compared the use of albumin to crystalloids specifically in patients with sepsis observed a reduction in mortality
- Given the higher cost of albumin and the lack of a definitive clinical benefit, the Panel recommends against the routine use of albumin for initial acute resuscitation of patients with COVID-19 and shock.

Additional Recommendations Based on General Principles of Critical Care

- The Panel recommends against using hydroxyethyl starches for intravascular volume replacement in patients with sepsis or septic shock.
- The Panel recommends norepinephrine as the first-choice vasopressor .
- The Panel recommends adding either **vasopressin** (up to 0.03 units/minute) or **epinephrine** to norepinephrine to raise mean arterial pressure to target or adding vasopressin (up to 0.03 units/ minute) to decrease norepinephrine dosage.

- When norepinephrine is available, the Panel recommends against using dopamine for patients with COVID-19 and shock.
- The Panel recommends against using low-dose dopamine for renal protection.
- The Panel recommends using dobutamine in patients who show evidence of cardiac dysfunction and persistent hypoperfusion despite adequate fluid loading and the use of vasopressor agents.
- The Panel recommends that all patients who require vasopressors have an arterial catheter placed as soon as practical, if resources are available.

- For adults with COVID-19 and refractory septic shock who are not receiving corticosteroids to treat their COVID-19, the Panel recommends using low-dose corticosteroid therapy (“shock reversal”) over no corticosteroid therapy.
- A typical corticosteroid regimen in septic shock is intravenous hydrocortisone 200 mg per day administered either as an infusion or in intermittent doses. The duration of hydrocortisone therapy is usually a clinical decision.
- Patients who are receiving corticosteroids for COVID-19 are receiving sufficient replacement therapy such that they do not require additional hydrocortisone.

Patients with COVID-19 in respiratory failure should be treated cautiously with intravenous fluids, especially in settings with limited availability of mechanical ventilation.

- Use a conservative fluid management strategy for ARDS patients without tissue hypoperfusion.
- In resuscitation for septic shock in adults, give 250–500 mL crystalloid fluid as a rapid bolus in the first 15–30 minutes and reassess for signs of fluid overload after each bolus.
- If there is no response to fluid loading or if signs of volume overload appear, reduce or discontinue fluid administration.

- Starches are associated with an increased risk of death and acute kidney injury compared to crystalloids. The effects of gelatins are less clear, but they are more expensive than crystalloids. Hypotonic (vs isotonic) solutions are less effective at increasing intravascular volume. Surviving Sepsis also suggests albumin for resuscitation when patients require substantial amounts of crystalloids, however this conditional recommendation is based on low-quality evidence.

International Fluid Academy

- Use balanced crystalloids (e.g. plasmalyte).
- Do not use starch solutions or gelatins.
- Do not use albumin in the early stages.
- For patients in need of fluid resuscitation:
  - Identify the cause of fluid deficit.
  - Assess for presence of shock or hypoperfusion.
  - Assess fluid responsiveness (see further).
- Give a bolus of 4 mL/kg of balanced crystalloids over 10-15 minutes.

- Fluid responsiveness is assessed before and after fluid administration with functional haemodynamics e.g. pulse pressure variation (PPV) or other tests e.g. passive leg raise test or end-expiratory occlusion test, or a combination.
- Mean arterial pressure and cardiac output are continuously monitored.
  - Early initiation of vasopressors: noradrenaline at low dose 0.05mcg/kg/min.
  - Consider the addition of vasopressin/argipressin when noradrenaline dose exceeds 0.5 mcg/kg/min

- Assess for the presence of fluid overload (i.e. 10% increase in body weight or volume excess from baseline).
  - Start de-resuscitation whenever possible.
  - Replace serum albumin to approximately 30 g/L with albumin 20%.
  - Use combination therapy of diuretics: loop + spironolactone + acetazolamide (when BE > 5) + indapamide (in cases of hypernatraemia).
  - Consider ultrafiltration (even in the absence of acute kidney injury) when diuretics fail to achieve zero fluid balance.

Maintenance fluids

- Do not administer maintenance fluids in patients who are eating and drinking sufficiently.
- Use balanced solutions.
- In patients requiring IV fluids for routine maintenance alone, the initial prescription should be restricted to:
  - 25–30 mL/kg/day (1 mL/kg/hr) of water
  - approximately 1 mmol/kg/day of potassium (K+)
  - approximately 1-1.5 mmol/kg/day of sodium (Na+)
  - approximately 1 mmol/kg/day of chloride (Cl-)
  - approximately 50–100 g/day (1-1.5 g/kg/day) of glucose to limit starvation ketosis

- The amount of fluid intake via other sources should be subtracted from the basic maintenance need of 1ml/kg/hr e.g. nutrition and fluid creep
- Fluid creep is defined as the sum of the volumes of these electrolytes, the small volumes to keep venous lines open (saline or glucose 5%) and the total volume used as a vehicle for medication.

با تشکر

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بهمن ۹۹